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### THE RELATIONSHIP OF *CROTALUS RUBER* AND *CROTALUS LUCASENSIS*

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The close relationship of *Crotalus ruber* and *Crotalus lucasensis* has long been recognized, for both are obviously derived from *Crotalus atrox*, as shown by lepidosis, pattern, and hemipenes. The problem of their relationship would have been settled long ago were it not for the fact that the gap that lies between their ranges is almost inaccessible. This is the Sierra de la Giganta in southern Baja California, along the Gulf of California coast. This range of mountains is quite suitable in character to occupation by either *ruber* or *lucasensis*, but the only north-south road in that section of the peninsula skirts far to the west of these mountains, in a desert not so much to the liking of these diamondbacks. Even so, *lucasensis* has been collected in this desert as far north as Yrais (Hiray), and 8 miles south of El Refugio; and there is a questionable record from 40 miles south of Comondú. *Ruber*, for its part, is found along the shores of Bahía de la Concepción, the most southerly specimen having been taken at the head of the bay, near La Cruces.

In July, 1938, Robert S. Hoard collected a series of 7 diamondbacks, which obviously show intergradational tendencies, at Loreto, near the north end of the Sierra de la Giganta about 60 miles southeast of Las Cruces. I had hoped that further specimens might be forthcoming from elsewhere in these mountains, but, after waiting 10 years without securing more, have now decided to see how strong a case for intergradation may be built upon them. Fortunately, both *ruber* and *lucasensis* are well represented in collections, so that their characters can be firmly established; the scale counts are available for 372 specimens of *ruber* and 348 of *lucasensis*. Of the *ruber* series, 72 are from Baja California, the rest from southern California.

*C. ruber* and *lucasensis* differ in scutellation and pattern. None of the scale differences is sufficiently restrictive or consistent to be useful as a key character, for there is much overlapping, but we can draw inferences from the trends in the Loreto specimens.

*C. lucasensis* has fewer scale rows, on the average, than *ruber*; 76 per cent of *lucasensis* have 27 or fewer, whereas 83 per cent of *ruber* have 28 or more. It is to be noted, however, that the Baja California specimens of *ruber* have a reduced percentage with 28 and more, only 65 per cent having the higher number. Of the Loreto specimens, 6 have 27 rows and one 29, thus favoring *lucasensis* in this character.

On the average, *ruber* has about 5 ventrals more than *lucasensis*, the figures being: *ruber* males 193.8, females 197.3; *lucasensis* males 188.8, females 192.6. The Loreto males have 188, 190, 192, 192; and the females 193, 195, and 196. In this respect the Loreto specimens are intermediate, with a slight leaning toward *lucasensis*.

The differences between the species in subcaudals and labials are of insufficient extent to be of value in diagnosis.

*C. ruber* has a somewhat higher percentage of divided first infralabials than *lucasensis* (91 to 87), and all of these scales in the Loreto specimens are divided; however, *lucasensis*, itself, runs so high in having this division that this cannot be considered of importance. The minimum scales between the supraoculars are slightly higher in *ruber* than *lucasensis* (averages 6.5 and 5.9), and here the Loreto specimens somewhat favor *ruber*, for 3 specimens have 7 scales in this series and the others 8.

The majority of *ruber* specimens have single loreals (mean 1.22 per side), while *lucasensis* usually has 2 or more (mean 1.96 per side). The Loreto specimens have single and paired loreals in equal numbers, so that they are intermediate in this character.

The body blotches in *ruber* average 36.3, in *lucasensis* 29.9. The Loreto specimens number 28, 29, 30 (4 specimens), and 31, thus definitely resembling *lucasensis*.

As to pattern and color, *ruber* tends toward red or red-brown, *lucasensis* toward yellow- or olive-brown.

Of the two, *lucasensis* is lighter and more brightly marked; the light scale rows bordering the dorsal diamonds are more accentuated,\* the head marks clearer, and the lateral angles of the blotches sharper, more diamond-like, and less often hexagonal or round as in *ruber*. *C. lucasensis*, more often than *ruber*, has light areas in the centers of the dorsal blotches. Light cross-marks on the supraoculars are more apparent in *lucasensis* than in *ruber*; and the light preocular stripe is wider, being usually 3 or more scales wide

\*This is also true of the desert specimens of *ruber* in San Diego County, California.

(at the second row of scales above the supralabials), rather than 2 or fewer as in *ruber*.

Surveying the 7 Loreto specimens with respect to these criteria, we find them intermediate. In color they are dark red-brown, somewhat more like *ruber* than *lucasensis*, but the light blotch-borders are more prominent than is usual in *ruber*. While the blotch shapes favor *ruber*, the light blotch centers characteristic of *lucasensis* are present, although less accentuated than is customary in the southern species. The light supraocular cross-marks are clearly present in 3 specimens, but faint or absent in the others. The light preocular stripes are clear in all specimens, and in none is the stripe less than 3 scales wide, thus showing an affinity for *lucasensis*.

Summarizing, it is my opinion that the Loreto specimens are intermediate, with a slight leaning toward *lucasensis*. Loreto is only 60 miles southeast of the head of Bahía de la Concepción, where pure *ruber* occurs, although admittedly not precisely the same in all characters as the *ruber* of San Diego County. But at least we now have evidence of an unbroken cline from the Santa Ana Mountains of southern California to Cape San Lucas at the southerly tip of Baja California, and only a single species should be recognized. The northern race should be known as *Crotalus ruber ruber* Cope, 1892; and the southern as *Crotalus ruber lucasensis* Van Denburgh, 1920.

*Crotalus r. lucasensis* is more like *C. atrox* than is *C. r. ruber*, notwithstanding their separation by the Gulf of California, whereas the *ruber* and *atrox* ranges approach each other closely at several points. Indeed, it is quite likely that they overlap in the vicinity of La Quinta and Indian Wells, Riverside County, California. But there are no suggestions of intergradation either here or at other points where the ranges are closely contiguous. However, I should not be surprised were the future to bring forth an occasional hybrid.

Despite my recent treatment of certain island forms, in considering them subspecies of mainland forms with which they can no longer intergrade, I do not believe it desirable to join *exsul* of Cedros Island with *ruber* of the mainland as a single species. Although the relationship between the two is readily apparent, I think that the known character differences are sufficient in extent to justify a continued specific separation. *C. exsul* is a better-differentiated form than the other island races that I have considered subspecies.

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